

REVIEW PROTOCOL FOR USING TECHNOLOGY TO SUPPORT POSTSECONDARY STUDENT LEARNING PRACTICE GUIDE VERSION 1.1 (JULY 2017)

This review-specific protocol guides the review of research that informs the What Works Clearinghouse (WWC) practice guide “Using Technology to Support Postsecondary Student Learning.” The review-specific protocol is used in conjunction with the [WWC Procedures and Standards Handbook \(version 3.0\)](#).

PURPOSE STATEMENT

This practice guide is intended to inform how technology can support effective pedagogical practice and, in turn, student-centered postsecondary learning. Evidence-based recommendations are made that support the thoughtful integration of technology into postsecondary instructional settings.

This thoughtful integration includes the use of technology to support instructional strategies that promote engaging, meaningful, and active learning environments. Technology also can be used to support personalized as well as collaborative learning experiences. Additionally, it can enable instructors to access real-time student data and track student progress toward a learning goal. As a result, student acquisition, application, and retention of knowledge are expected to increase.

This practice guide is geared toward faculty, instructional designers, and other professional staff who provide or support learning technology and instruction in postsecondary settings (e.g., classroom technology design and support staff, Teaching Center staff, learning consultants, librarians who focus on technology or teaching practice, and administrators in positions to adopt technology practices). It should interest those who want to use technology to effectively support the achievement of postsecondary students.

The following core research question guides this review: “*How can technology be used to improve students’ postsecondary learning?*” Specific recommendations in the guide will center on questions such as:

- What types of technology have been shown to improve postsecondary students’ attendance, credit accumulation, persistence, academic achievement, attainment, and/or labor market outcomes?
- How can the adoption of innovative technologies be facilitated in institutions of higher education?

- In what ways can technologies be used to maximize classroom learning?
- How can technologies supplement student-centered approaches to blended or online learning?¹

The guide will address the application of technology in a number of instructional settings, including classrooms, online courses, and blended (or hybrid) courses.

ELIGIBILITY CRITERIA

Eligible Populations

In this review, the following populations are of interest:

- **Grade range.** Students enrolled in institutions of higher education will be included in the review. This includes students in two-year and four-year institutions, graduate and professional students, as well as students in technical or vocational education programs. Students in developmental education courses are also eligible. Students enrolled in courses designed for enrichment or as non-credit-bearing electives are not eligible.
- **Student characteristics.** Studies with more than 50% special needs students or more than 50% second-language students are not eligible for review.
- **Location.** Studies must occur in the United States and be published in English.
- **Subgroups.** The panel will consider the following subgroups of interest to the review:
 - Nontraditional students
 - Students receiving developmental education
 - Students in graduate courses

¹ Although the term “student-centered learning” is sometimes construed to refer to personalized learning, we have broadly defined student-centered learning as instruction that provides students opportunities for engagement in learning (e.g., participating actively in discussions, independently exploring course material, contributing to the instructional material, or guiding the course of study). This is in contrast to teacher-centered learning in a traditional “stand and deliver” format, which typically does not leverage technology to the extent that student-centered instruction does. Although this practice guide will include the application of technology in teacher-centered learning environments, our primary focus will be on exploring the opportunities that technology can provide to transform students’ postsecondary learning experiences.

Eligible Interventions

The review will consider studies of pedagogical strategies that incorporate technology into traditional classroom, blended, or online learning. The following characteristics of an intervention must be known so that the intervention can be reliably implemented with different participants, in other settings, or at other times:

- Intervention description: skills being targeted, class of technology tools (outlined below), approach to enhancing the skill(s) (e.g., strategies, activities, and materials), unit of delivery of the intervention (for example, whole group, individual), medium/media of delivery (for example, teacher-led instruction or software), and targeted population
- Intervention duration and intensity of services provided
- Description of the level of effort needed (including number of individuals involved) to deliver or administer the intervention

In this review, the following types of tools and affordances qualify as technology interventions:

- ***Collaboration and Communications Tools:*** These tools are designed to foster deeper communication and collaboration both among students and between instructors and students. Examples of these tools include discussion management platforms, mobile apps, blogs, wikis, screen-sharing tools, and social networking. They can be used with a number of instructional strategies including team-based learning, project-based learning, socio-cultural learning, case-based learning, and peer-to-peer feedback. Pedagogical affordances of these tools include:
 - Enabling asynchronous and synchronous communication and collaboration
 - Allowing students and/or educators to work together in peer-to-peer or group activities
 - Encouraging reflection and articulation
 - Encouraging multiple perspectives (diversity) in thinking
 - Enabling students and educators to access and contribute to shared workspaces
- ***Content Creation and Delivery Tools:*** These tools are designed to leverage technology to produce new course content or materials, or to produce homework or other independent study material. Examples of content creation and delivery tools include learning management system (LMS) tools, online video platforms, interactive hypervideos (i.e., videos with user-controlled navigation), and resource-sharing

tools. Instructional strategies supported by these tools include scaffolding and active learning. Pedagogical affordances of these tools include:

- Enabling instructors to create, deliver, and manage web-based content and learning activities
 - Allowing students to contribute resources and create, edit, and manage content (including assignments)
 - Enabling students to demonstrate their understanding and application of course content
 - Facilitating multi-media instruction (including visualization, lecture capture, and online interactive learning modules)
 - Fostering active learning
 - Providing options for students to engage in digital storytelling
 - Providing options for students to access course materials and engage with content in different ways to demonstrate learning (drawing on principles of Universal Design for Learning)
- **Personalized Learning Tools:** These tools are designed to personalize a student’s learning experience and ability to explore material independently. Examples of personalized learning tools include student portfolios, note-taking tools, adaptive learning tools, recommender systems, and web-based self-learning tools. Instructional strategies using these tools include competency-based learning, self-directed learning, differentiated instruction, and mastery-based learning. Pedagogical affordances of these tools include:
 - Allowing students to explore course content, work on assignments, and participate in learning activities
 - Assisting students in processing and organizing course content
 - Offering resources for developing metacognitive skills
 - Supporting individualized learning pathways
 - Supporting student-centered learning
 - Offering adaptive learning features that allow for tailored support and guidance
- **Immersive Learning Tools:** These tools are designed to engage students in virtual environments or real-world simulations to apply classroom learning in authentic environments. Examples of immersive learning tools include simulations, role playing, virtual labs, technology-based manipulatives, and immersive virtual worlds.

Instructional strategies using these tools include role playing, case-based learning, scenario-based learning, game-based learning, and problem-based learning.

Pedagogical affordances of these tools include:

- Fostering active, engaged learning experiences
 - Allowing instructors to organize learning around real-world challenges and scenarios
 - Providing opportunities for hands-on problem solving (individual and collaborative) to foster deeper understanding of content and concepts
 - Providing a safe space to fail at a task, but with realistic consequences
- **Assessment and Evaluation Tools:** These tools are designed to leverage technology to assess student learning and, in some cases, tailor instruction based on assessment results. Examples of assessment and evaluation tools include test-generation tools, self-assessment tools, and student progress tools, which can be used for peer assessment and self-assessment in addition to traditional instructor-administered assessments. Pedagogical affordances of these tools include:
 - Allowing for measurement and evaluation of learning gains (including formative and summative assessment)
 - Enabling real-time assessment of student learning
 - Documenting learning progress, skill development, and credits/credentials earned
 - Providing rubrics for assessment
 - Accommodating design-based and iterative learning processes
- **Management and Advising Tools:** These tools are designed to leverage technology to help instructors manage the administration of a course and focus more time on instruction. Examples of management tools include learning management systems, online feedback tools, online gradebooks, and homework generation tools. These management tools can support instructional strategies such as competency-based learning, and mastery-based learning. Pedagogical affordances of these tools include:
 - Facilitating instructional support
 - Helping organize and manipulate content
 - Gathering information about student learning for the purpose of tailoring instruction and/or interventions
 - Supporting self-directed learning

- ***Institutional Practices:*** In order to leverage or propagate technology-based solutions in postsecondary settings, systemic change may be needed. Institutional strategies for identifying, adopting, or scaling up technologies will also be considered.

Both “branded” and “non-branded” interventions will be reviewed, though branded interventions will not be endorsed. Branded interventions are commercial or published practices that may possess any of the following characteristics:

- An external developer who provides technical assistance (e.g., instructions/guidance on the implementation of the intervention) or sells or distributes the intervention.
- Trademark or copyright.

Eligible Research

The *WWC Procedures and Standards Handbook* discusses the types of research reviewed by the WWC in Section II Developing the Review Protocol and Identifying Relevant Literature (p. 4). Additionally, in this review, the following parameters define the scope of research studies to be included:

- ***Topic.*** The recommendations in the practice guide will focus on incorporating technology to improve postsecondary instruction and student outcomes.
- ***Time frame.*** The study must have been published between 1997 and June 2017; earlier or later work will be reviewed if suggested by a panelist.
- ***Sample.*** The study sample must meet the requirements described in the “Eligible Populations” section above.
- ***Language.*** The study must be available in English to be included in the review.
- ***Location.*** Studies can occur outside the United States, but research must be published in English.
- ***Publication.*** Conference papers and doctoral dissertations are eligible; however, masters’ theses are not unless requested by a panelist.

Eligible Outcomes

The panel is primarily concerned with the use of technology to support effective pedagogical practice and, in turn, improve postsecondary student outcomes.

This review includes outcomes in the following domains:

- **Access and enrollment** refers to the process of applying to, actually enrolling, and attending a postsecondary institution. Examples of ways that enrollment might be operationally defined in studies include: (a) actual enrollment in college, (b) number and/or selectivity of admitted and/or enrolling institutions, (c) enrollment by institution type (2 year vs. 4 year), (d) intensity of enrollment (full time vs. part time), and (e) timing of enrollment (e.g., immediate vs. delayed enrollment after high school). On a case-by-case basis, the WWC may accept measures of intentions to enroll, though measures of actual enrollment are preferred when both types are available.
- **College attendance** refers to outcomes that measure attendance rates or absenteeism at school. Ways that attendance might be operationalized include the number or proportion of days absent or in attendance during a school term, proportion of students with excessive absences, referrals for truancy, and the like. Objective measures of attendance, such as those from school administrative records are preferred, but student reported measures are acceptable if a more objective measure is not available.
- **Credit accumulation and persistence** refers to progress toward the completion of a degree, certificate, or program. Examples of ways that credit accumulation might be operationally defined in studies include: (a) number of college-level credits earned, (b) number of terms of continuous enrollment, and (c) enrolled vs. did not enroll the next semester. The number of non-college level credits earned (e.g., developmental credits) is not an eligible measure of credit accumulation. On a case-by-case basis, the WWC may accept measures of intentions to persist, though measures of actual persistence are preferred when both types are available.
- **Academic achievement** refers to the extent to which students master academic content. As such, eligible measures of academic achievement are those that arise naturally from student educational experiences. Examples of ways that academic achievement might be operationally defined in studies include (a) final grade in a single college-level course, (b) grade point average in college-level courses, (c) the ratio of college-level courses passed vs. failed, and (d) test scores measuring academic achievement (including industry exams) or performance on a particular project.
- **Attainment** refers to the completion of a degree, certificate, or program. Examples of ways attainment might be operationally defined in a study include (a) certificate completion rates and (b) degree completion rates.
- **Labor market** refers to outcomes related to employment after the postsecondary experience. Examples of ways that labor market outcomes might be operationally defined in studies include (a) employed vs. not, (b) employed full-time vs. employed part-time, (c) employed in field of study vs. not, and (d) income earned.
- **Motivation and engagement** refers to outcomes that measure motivation (intrinsic and extrinsic), engagement, and related constructs such as goal orientation and self-

regulation. To be considered eligible, measures in this domain must meet existing WWC outcome criteria and cite research documenting that the measure is well-constructed (i.e., has content/face validity and/or structural validity).

EVIDENCE STANDARDS

Eligible studies are assessed against WWC evidence standards, as described in the *WWC Procedures and Standards Handbook* Section III: Screening and Reviewing Studies (pp. 8 – 21).

Sample Attrition

The *WWC Procedures and Standards Handbook* discusses the sample attrition standards used by the WWC in Section III Subsection B 2 Sample Attrition: Is the combination of overall and differential attrition high? (pp. 11 – 15).

This review uses the *liberal* boundary for attrition. This boundary was selected based on the assumption that most attrition in studies of postsecondary instruction is due to factors that are not strongly related to treatment status, such as absences on the days that assessments are conducted. The *WWC Procedures and Standards Handbook* contains a figure illustrating the attrition boundary and an associated table with attrition levels that define high and low attrition. Based on the choice of the boundary, the study review guide calculates attrition and whether it is high or low.

Baseline Equivalence

If the study design is a randomized controlled trial or regression discontinuity design with high levels of attrition, or a quasi-experimental design, the study must demonstrate baseline equivalence of the intervention and comparison groups for the analytic sample. The onus for demonstrating equivalence in these studies rests with the authors. The *WWC Procedures and Standards Handbook* discusses how authors must demonstrate baseline equivalence in Section III Subsection B 3 Baseline equivalence: Is equivalence established at baseline for the groups in the analytic sample? (pp. 15 – 16).

Equivalence must be established in the domain of the outcome measure. If baseline differences exceed 0.25 standard deviations for any of the measures within a domain, the study will not meet evidence standards within this domain.

For this review, in those cases where a pretest from the same domain is not available, the following variables can be used to establish baseline equivalence:

- A continuously-scaled baseline measure of academic achievement (e.g., high school grade point average, SAT/ACT scores), and

- A baseline measure of student socioeconomic status (e.g., FAFSA expected family contribution, family income, free- or reduced-price lunch status, parent education levels, Pell grant eligibility)

In cases where multiple baseline measures of socioeconomic status (SES) and/or academic achievement were available, the lead methodologist will be responsible for selecting the variable (or variables) to be used in the baseline equivalence assessment. For example, if both math and verbal scores on a college entrance exam are available, and the primary outcome is whether students passed a college level math course, then the lead methodologist could decide that the score on the math portion of the entrance exam is the only achievement measure on which baseline equivalence should be assessed. However, if the primary outcome is attainment, then the lead methodologist could decide to assess equivalence on both the math subtest and the verbal subtest.

The review requires that in a domain that requires statistical adjustments the adjustment is made only for that outcome. For example, if A, B, and C are available as pre- and post-intervention measures, and the pre-intervention difference in B requires statistical adjustment, only the analysis of outcome B must adjust for B.

Review team leadership should be notified if a study has baseline differences greater than 0.25 SD for any of the following characteristics, since it could be evidence that the populations were drawn from different settings and that the intervention and comparison groups are not sufficiently comparable for the purpose of the review:

- Percentage of students with low socioeconomic status
- Race or ethnicity
- Gender
- Percentage of students who speak English as a second language

Review team leadership may decide the differences indicate that the comparison group is not adequate for the purposes of this review.

Outcomes

The *WWC Procedures and Standards Handbook* discusses the types of outcomes, criteria the outcomes must meet, and how outcomes are reported by the WWC in Section 3 Subsection B 4 Outcome Eligibility and Reliability (pp. 16 – 19). This review follows the general guidance regarding reliability, outcomes measured at different points in time, impacts measured at different points in time, composite and subscale scores, subgroup findings, categorical ordinal measures, and estimated effects using imputed data.

Measures collected after the intervention ends are acceptable for this guide. To consistently examine effects across different interventions, measures administered closest to the end of the intervention will affect the level of evidence, but other outcome findings will also be reported in the guide appendix. Statistical adjustments to control for multiple comparisons will be computed within individual follow-up periods. Separate adjustments will be computed for the following follow-up periods, where appropriate: 2 weeks to 1 month, more than 1 to 3 months, more than 3 to 6 months, and more than 6 months. All outcomes within 2 weeks of the end of the intervention will be included in the immediate posttest adjustment. We will also report transfer outcomes – those that require students to apply concepts to new contexts – separately.

Study authors may use informal and experimenter-designed measures. Any experimenter-designed measure is acceptable as long as the measure assesses an eligible outcome domain and the measure is not overlapped with the intervention. When the review team is unable to determine the appropriateness of a measure, the panel chair will assist with determining whether the measure is acceptable.

Statistical Adjustments

The *WWC Procedures and Standards Handbook* discusses the types of adjustments made by the WWC in Section IV Subsection B Statistical Significance of Findings (p. 24).

Other Study Designs

Studies that use regression discontinuity or single-case designs are eligible for review using the appropriate pilot standards.

The *WWC Procedures and Standards Handbook* discusses the pilot standards for reviewing regression discontinuity design studies in Appendix D.

The *WWC Procedures and Standards Handbook* discusses the pilot standards for reviewing single-case design studies in Appendix E.

Assigning Levels of Evidence

Practice guide panels rely on a set of definitions to determine the level of evidence supporting their recommendations (Table 1). The Validity and Effects on Relevant Outcomes criteria are established by the review team, while the panel is ultimately responsible for assessing the evidence base for other criteria.

Table 1: Levels of Evidence for Practice Guide Recommendations

Criteria	Strong Evidence Base	Moderate Evidence Base	Minimal Evidence Base
Validity	The research has high internal validity and high external validity based on studies that meet standards.	The research has high internal validity but moderate external validity or high external validity but moderate internal validity.	The research may include evidence from studies that do not meet the criteria for moderate or strong evidence.
Effects on relevant outcomes	The research shows consistent positive effects without contradictory evidence in studies with high internal validity.	The research shows a preponderance of evidence of positive effects. Contradictory evidence must be discussed and considered with regard to relevance to the scope of the guide and the intensity of the recommendation as a component of the intervention evaluated.	There may be weak or contradictory evidence of effects.
Relevance	The research has direct relevance to scope—relevant context, sample, comparisons, and outcomes evaluated.	Relevance to scope may vary. At least some research is relevant to scope.	The research may be out of the scope of the practice guide.
Relationship between research and recommendations	Direct test of the recommendation in the studies or the recommendation is a major component of the intervention tested in studies.	Intensity of the recommendation as a component of the interventions evaluated in the studies may vary.	Studies for which the intensity of the recommendation as a component of the interventions evaluated in the studies is low, and/or the recommendation reflects expert opinion based on reasonable extrapolations of research.
Panel confidence	Panel has a high degree of confidence that a given practice is effective.	The panel determines that the research does not rise to the level of strong but is more compelling than a minimal level of evidence. Panel may not be confident about whether the research has effectively controlled for other explanations or whether the practice would be effective in most or all contexts.	In the panel’s opinion, the recommendation must be addressed as part of the practice guide; however, the panel cannot point to a body of research that rises to the level of moderate or strong.
Expert opinion	Not applicable	Not applicable.	Expert opinion based on defensible interpretation of theory.

Criteria	Strong Evidence Base	Moderate Evidence Base	Minimal Evidence Base
When assessment is the focus of the recommendation	Assessments meet the standards of <i>The Standards for Educational and Psychological Testing</i> .	For assessments, evidence of reliability meets <i>The Standards for Educational and Psychological Testing</i> but with evidence of validity from samples not adequately representative of the population on which the recommendation is focused.	Not applicable.

APPENDIX A: Procedures for Conducting the Literature Search

The *WWC Procedures and Standards Handbook* discusses the procedures for conducting a literature search in Section II Developing the Review Protocol and Identifying Relevant Literature (p. 4) and in Appendix B Policies for Searching and Prioritizing Studies for Review.

Search Terms

The following table presents the search terms by category.

Category	Search Terms	
Topic: Collaboration and Communication Tools	<ul style="list-style-type: none"> • Discussion forum* • Discussion board* • Discussion management • Smartboard* • Interactive white board* • Blog* • Microblog* • Wiki* • Real-time chat • Instant messaging • Active learning classroom • Classroom-based learning environment* • Collaboration tool* • Multiple perspectives • Shared knowledge 	<ul style="list-style-type: none"> • Screen sharing • Virtual session* • Social network* • Immediate feedback • Rapid feedback • Peer feedback • Peer-based feedback • Social learning • Makerspace* • Group-regulated learning • Problem-based learning • Communication tool* • Nudging • Texting • Video feedback • Project*based learning
Topic: Content Creation and Delivery Tools	<ul style="list-style-type: none"> • Content creation • Content delivery • Learning management system* • HTML editor* • Online video* • Audio editor* • Video editor* • Resource-sharing • Tagging 	<ul style="list-style-type: none"> • 3D printing • 3-D printing • Flipped classroom* • Lecture tool* • Information literacy • Information fluency • Active learning* • Open educational resource* • Open education resource* • Lecture captur*

Category	Search Terms	
	<ul style="list-style-type: none"> • Hypervideo* • Group annotation • Badging • OER/Open Educational Resources 	<ul style="list-style-type: none"> • Open access textbook* • Open source textbook* • Openly licensed resource*
Topic: Personalized Learning Tools	<ul style="list-style-type: none"> • Personalized learn* • Personal Learning Environment* (PLE) • Student portfolio* • E-portfolio* • Social annotation • Content aggregation • Adaptive learning • Micro-adaptive* • Response-sensitive* • Corrective feedback • Project based learning* • Gamification • Self-directed learning 	<ul style="list-style-type: none"> • Cognitive tutor* • Learner*directed • E-learning • Elearning • Self-regulated learning • Co-regulated learning • Micro-credential* • Recommender system* • Competency*based learning • Lifelong learning • Computational learning • Mastery*based learning • Game*based learning • Audio triangulation
Topic: Immersive Learning Tools	<ul style="list-style-type: none"> • Simulation* • Virtual lab* • Technology*based manipulative* • Augmented reality • Mixed reality • Worked example* • eSport* • Situational judgment test* • Media*based scenario* • Case*based learning • Hands*on learning • Design*based learning • Case method* • Wearables 	<ul style="list-style-type: none"> • Immersive virtual* • Habitable world* • OpenSim • Massively multiplayer online role-playing* • Rapid prototyping • Case*based learning • Geospatial aware* • Role play* • Scenario*based learning • Experiential learning • Authentic learning • Media*based case stud* • Immersive learn* • Wearable computing

Category	Search Terms	
Topic: Assessment and Evaluation Tools (Formative and Summative Assessment Tools)	<ul style="list-style-type: none"> • Assessment technolog* • Evaluation technolog* • Self-assessment • Student response* • Classroom response* • Goal generation • Goal setting • Pre-assessment • Placement tool* • Calibrated peer review • Formative assess* • Summative assess* • Clickers • Learner analytics • Learning analytics • Assessment tool* 	<ul style="list-style-type: none"> • Rubric*based assessment • Rubric generation • Rubric development • Rubric creation • Adaptive assess* • Automated peer* • Continuous coaching • Diagnostic tool • Authentic assess* • Peer assess* • Collective assess* • Coaching tool* • Progress tracking tool* • Evaluation tool* • Online assessment
Topic: Management and Advising Tools	<ul style="list-style-type: none"> • Test*generation* • Homework*generation* • Online gradebook* 	<ul style="list-style-type: none"> • Student success collaborative* • Online marking • Learning Management System
Intervention	<ul style="list-style-type: none"> • Interven* • Curricul* • Program* • Strateg* • Instruct* • Teach* • Online learning 	<ul style="list-style-type: none"> • Train* • Approach* • Monitor* • Treat* • Self-regulat* • Transfer • Blended learning
Population	<ul style="list-style-type: none"> • College • Postsecondary • Tertiary ed* • Community college • Developmental ed* • University 	<ul style="list-style-type: none"> • Higher education • Freshman • Sophomore • Junior • Senior
Study Design	<ul style="list-style-type: none"> • Control group* • Comparison group* • Matched group* 	<ul style="list-style-type: none"> • RCT • Quasi*experiment* • QED

Category	Search Terms	
	<ul style="list-style-type: none"> • Treatment* • Random* • Assign* • Baseline • Experiment* • Evaluat* • Impact* • Effectiveness • Causal* • Post*test* • Pre*test* • Randomized controlled trial 	<ul style="list-style-type: none"> • Regression discontinuity • Changing criterion • Intrasubject replication • Multiple baseline • Multi*element • Single case • Single subject • ABAB • Alternating treatment • Simultaneous treatment • Reversal design • Withdrawal design
Outcomes	<ul style="list-style-type: none"> • Achieve* • Improve* • Instructional effectiveness • Outcome* • Effect* • Develop* • Access • Enroll* • Selectiv* • Grade* • Degree 	<ul style="list-style-type: none"> • Skill* • Assess* • Test* • Progress* • Acqui* • Persist* • Engage* • Attend* • Credit* • Complet* • Certificate

The asterisk (*) in a search term means that any word that begins with the specified letters is considered to be the search term (e.g., “blog” and “blogs” are both search terms for blog*).

Additional Sources

The review team will search the WWC database of previously reviewed studies to identify studies that have met standards in prior reviews. The review team will also solicit study recommendations of publicly available studies from panel members.